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TRAINING SYSTEMS FOR MAINTENANCE (TRANSFORM) SYSTEM OVERVIEW

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This document provides a brief description of the Training Systems for Maintenance (TRANSFORM) system. This system overview is directed toward management personnel that use the TRANSFORM software system. TRANSFORM was specifically designed for Air Force applications performed by the 3306 Test and Evaluation Squadron, Edwards AFB, CA. The TRANSFORM system functions are detailed, the hardware and software requirements are tested, and the data/data structures are explained.

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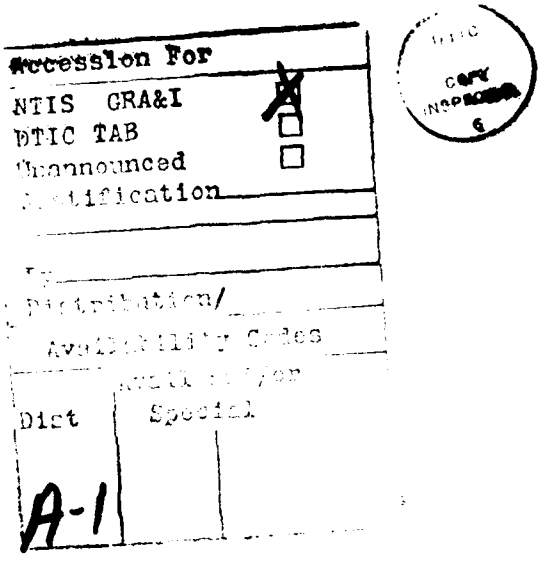
SUMMARY

An automated interface between Logistics Support Analysis (LSA) data and the Instructional Systems Development (ISD) procedures provides training developers for emerging weapon systems with a means to identify training requirements earlier in the weapon system acquisition phase.

This Training Systems for Maintenance (TRANSFORM) User's Manual describes the current methods and procedures used by the 3306th Test and Evaluation Squadron in applying the Instructional Systems Development process and interfacing with other Air Force agencies.



PREFACE

This technical paper is produced under United States Navy Contract No. N61339-87-D0007, Training Systems for Maintenance (TRANSFORM). The work was performed under AFHRL Work Unit 7719-19-11 by Dynamics Research Corporation. The objective of TRANSFORM is to provide the Air Force with an alternate system to support the training development mission of the 3306 Test and Evaluation Squadron, Edwards Air Force Base, California. A major goal of TRANSFORM is to improve key ISD analysis steps that would significantly benefit from automation and decision support features.

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INTRODUCTION

1.1 INSTRUCTIONAL SYSTEM DEVELOPMENT

Instructional Systems Development (ISD) is a systems engineering approach to training. ISD is a structured series of analytical steps that determine the training system design requirements for a given weapon system. ISD considers the relative need and appropriate methods to train each weapon system task and task element, and assesses the skills and knowledge of a target student population. ISD uses an iterative, building-block approach to determine a weapon system's training system design requirements.

1.2 LOGISTIC SUPPORT ANALYSIS RECORD

The Logistic Support Analysis Record (LSAR) contains design and logistics information for a weapon system. Logistic Support Analysis (LSA) is the iterative process that regularly updates the system's design and supportability information through all phases of acquisition.

1.3 TRAINING SYSTEMS FOR MAINTENANCE

Training designers rely on the availability of up-to-date LSA data early in the acquisition process to develop a training system that reflects the current design of a weapon system. Such a training system must be easily adaptable to all engineering design changes and must meet the maintainability and supportability objectives of the weapon system. Using LSAR data to support the ISD training requirements analysis process is a key feature of the ISD procedures performed by the 3306th Training Development and Evaluation Squadron (TDES) at Edwards Air Force Base, California. Under the name Training System for Maintenance (TRANSFORM), a research and development effort was begun to assess the feasibility of implementing an automated ISD analysis tool (3306th TDES ISD procedures) integrated with the LSA process. The early TRANSFORM efforts concluded that an operational TRANSFORM system could successfully incorporate the delivery of new and modified weapon system information information through an automated interface of LSAR data and the ISD process.

The apparent benefits of the TRANSFORM design were attractive to not only the Air Force but to other Services. Although ISD procedures differ across Services, each Service conforms to the same generic ISD approach. The most uniquely appealing feature of the TRANSFORM design was the automated interface with LSAR data.

The outgrowth of the multi-service interest in the TRANSFORM effort was the ongoing design and implementation effort called the Joint Service ISD/LSAR Decision Support System (DSS). The Joint Service ISD/LSAR DSS uses the TRANSFORM LSAR-to-ISD interface design, but also incorporates a range of user-selectable ISD tools and techniques applicable to service-specific and situational ISD analyses. The ISD/LSAR DSS effort included an in-depth functional analysis of many Joint Service ISD systems and has extended the TRANSFORM 3306th TDES ISD methodology to accommodate all Services. TRANSFORM is not a software system in addition to the ISD/LSAR DSS. Rather, it is the subset of ISD/LSAR DSS Joint Service ISD procedures that are performed by the 3306th TDES plus all ISD/LSAR DSS LSAR data extraction and manipulation procedures. Additionally, the TRANSFORM set of ISD procedures will include more comprehensive and flexible training media selection models to augment current 3306th TDES media selection logic.

Figure 1-1 is an arrangement of Joint Service ISD/LSAR DSS procedures. The ISD/LSAR DSS consists of LSAR data input routines and Joint Service ISD analysis processes. The system includes utility functions that provide system security, database administration, report generation, and ISD analysis functions. In Figure 1-1, the TRANSFORM set of LSAR manipulation and ISD procedures are shaded. The procedures with bold outline are those that are implemented in the Version 2.0 interim Joint Service ISD/LSAR DSS. This set of procedures is referred to hereafter as simply TRANSFORM or the TRANSFORM system.

1.4 THE TRANSFORM SYSTEM DESCRIPTION OVERVIEW

Section 2.0 contains a brief description of the TRANSFORM system. The TRANSFORM system functions are detailed in section 2.1, TRANSFORM hardware/software requirements are listed in Section 2.2, and TRANSFORM data/data structures are discussed in Section 2.3.

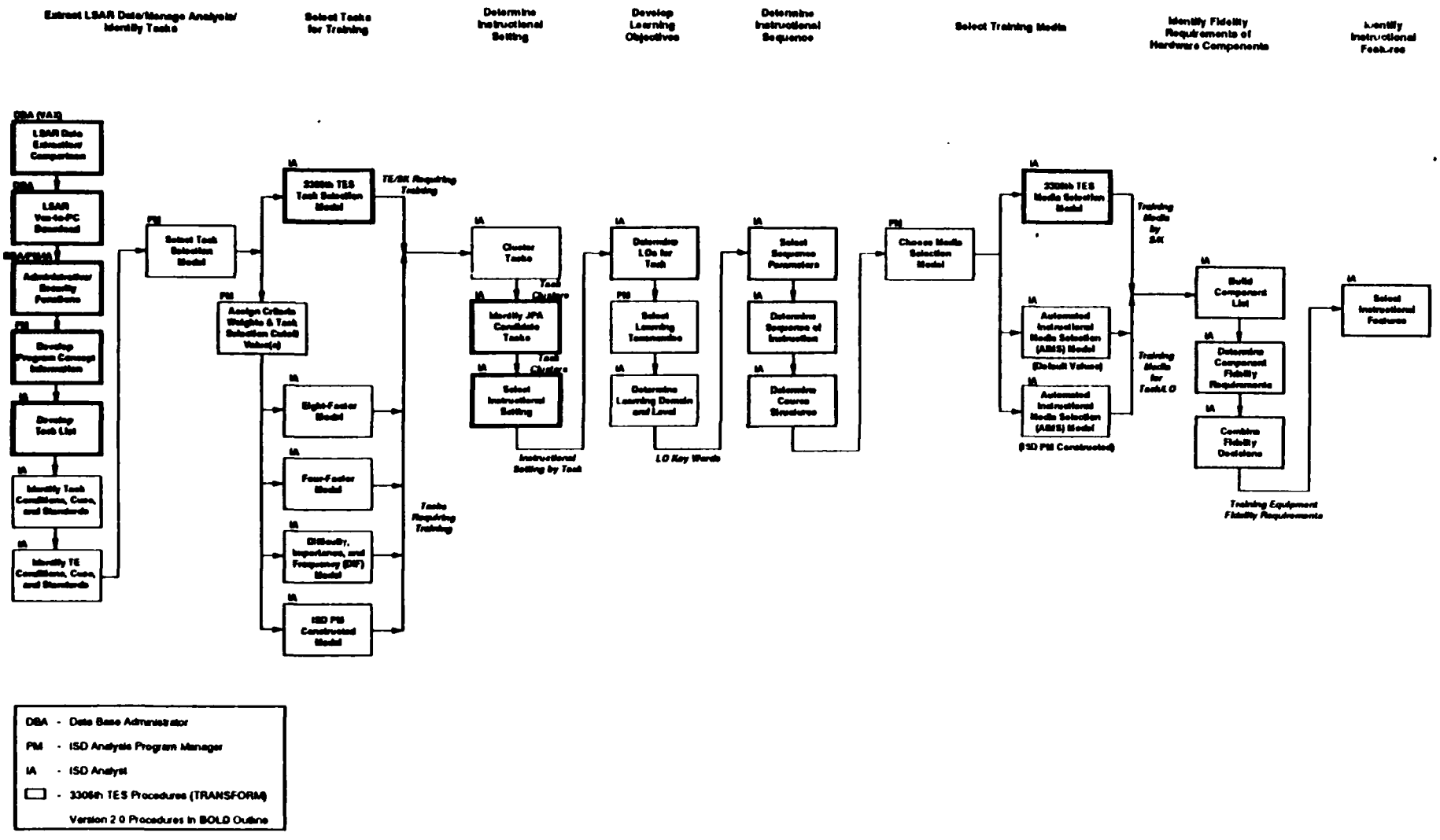

Figure 1-1. The Joint Service ISD/LSAR DSS

SECTION 2.0

TRANSFORM SYSTEM DESCRIPTION

TRANSFORM provides an automated link for LSAR data to feed the ISD process as the LSA proceeds during a weapon system acquisition. The automated ISD to LSAR data interface is a powerful technique that effectively integrates concurrent LSA and ISD analysis efforts. The automated link to LSAR data allows ISD analysts more time to effectively evaluate a weapon system's training requirements. TRANSFORM provides easy access to current LSAR data which enables training devices and materials to more accurately reflect dynamic weapon system designs. Also, automated ISD procedures eliminate labor-intensive data handling tasks and allow training analysts to effectively focus on analyzing training system requirements.

The TRANSFORM system architecture is depicted in Figure 2-1. TRANSFORM input consists of LSAR data elements and information entered by the users. The LSAR is processed on a VAX and the required data elements are transferred electronically to the TRANSFORM Local Area Network (LAN).

TRANSFORM consists of LSAR data input routines, ISD analysis processes, and training design procedures that reflect and accommodate service-specific ISD procedures. The system includes utility functions that provide system security, database administration, report generation, and ISD analysis functions. Within the ISD analysis functions, the ISD decision audit trail is documented on automated worksheets. Decision support logic aids in selecting tasks that require training, selecting instructional settings, selecting training media, sequencing instruction, and identifying training equipment fidelity requirements. TRANSFORM presents LSAR and other analysis-related data to the analyst to assist in making ISD decisions.

Within TRANSFORM, automated ISD analysis and data manipulation steps are organized and sequenced according to approved ISD guidance documents and satisfy many existing and emerging Joint Service training requirements as specified in MIL-STD-1379B/C/D and MIL-T-29053B.

2.1 TRANSFORM SYSTEM FUNCTIONS

TRANSFORM functions are described in terms of five main user categories:

- Database Administration (DA)
- Program Manager (PM)
- ISD Analyst (IA)

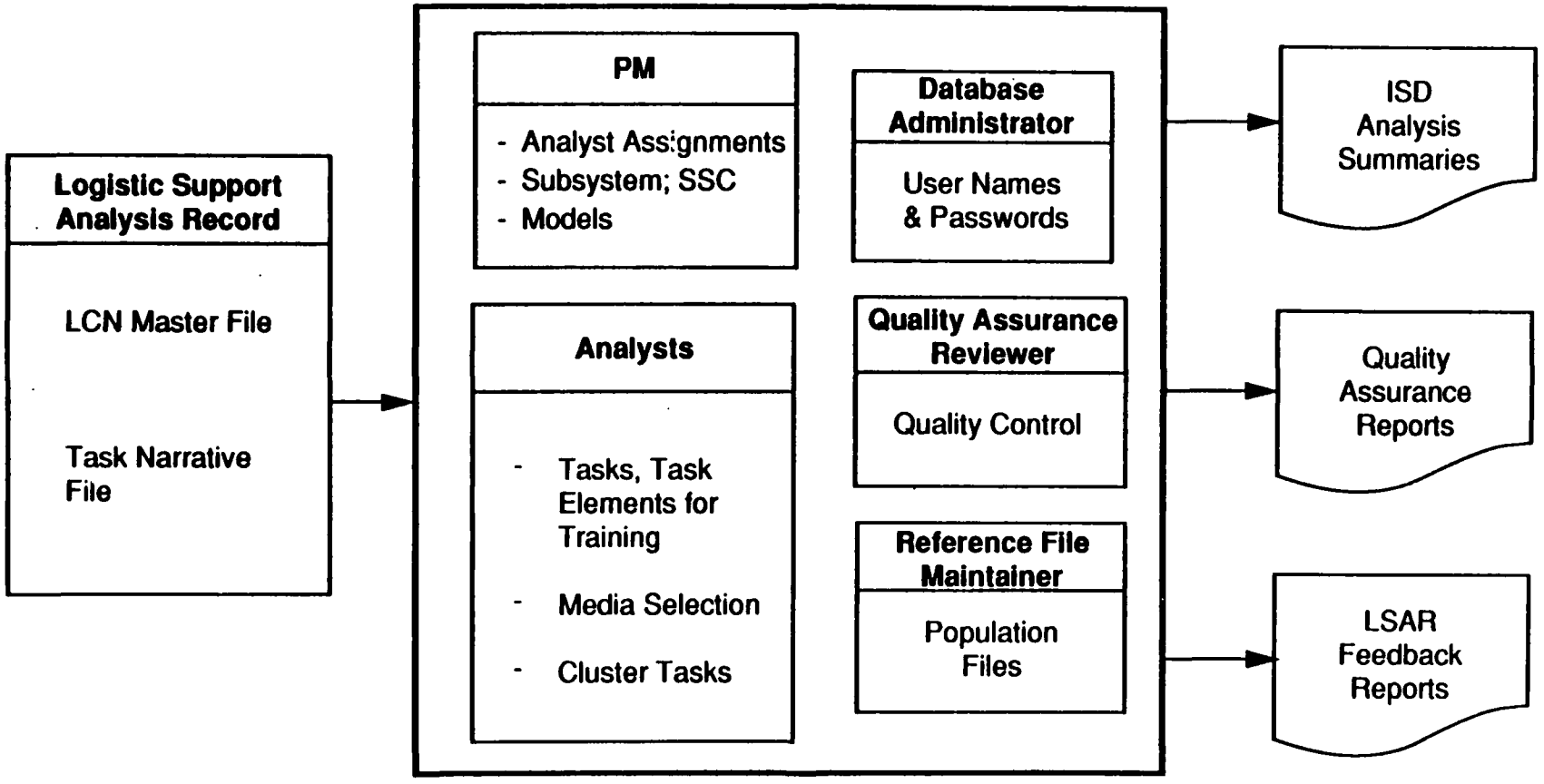

Figure 2-1. TRANSFORM System Architecture.

- Quality Assurance Reviewer (QAR)
- Reference File Maintainer (RFM)

Each user category is defined in terms of levels of responsibility that relate directly to options on each user's Main Menu. Thus, TRANSFORM functions are discussed as they appear in each user's menu structure.

2.1.1 Database Administrator (DA)

Options on the DA's Main Manu are:

- Download LSAR Data
- Maintain Usernames and Passwords
- Assign Program Managers

2.1.1.1 Download Data

The Database Administrator downloads the LSAR data to the TRANSFORM database. This process takes the extracted LSAR data elements and makes them available to users by loading them into the TRANSFORM LAN.

2.1.1.2 Maintain Usernames and Passwords

The Database Administrator is responsible for maintaining the usernames and paswords of all TRANSFORM users. Username/password assignment must occur before a user can gain access to TRANSFORM.

2.1.1.3 Assign Program Managers

To begin an ISD study for a weapon system, the Database Administrator must assign a Program Manager to the weapon system. A Program Manager is assigned by selecting a weapon system and assigning a TRANSFORM user responsibility for that weapon system.

2.1.2 Program Manager (PM)

Options on the PM's Main Menu are:

- Weapon System Concept Information
- Subsystem List
- Skill Specialty List
- Task Selection Model
- Media Selection Model
- Reports
- Archive

2.1.2.1 Weapon System Concept Information

The Program Manager uses available weapon system program documentation to describe the system's training, operational, and

maintenance concepts. The concept information is available for reference by any TRANSFORM user at any point during the ISD analysis.

2.1.2.2 Subsystem List

The PM creates a subsystem list for the weapon system ISD study. The subsystem list establishes the structure for the ISD analysis. If LSAR data are available, the subsystem list is automatically created and modifications can be made. As the LSAR is updated, the ISD PM compares the updated LSAR subsystem names with the ISD subsystem list. The PM has the option to analyze all LSAR changes and decide whether or not to incorporate the changes in the ISD subsystem list. After the subsystem list is created, the PM assigns one TRANSFORM user as Subsystem Lead Analyst for each subsystem.

2.1.2.3 Skill Specialty List

The PM creates and maintains a skill specialty list of the skill specialty codes expected to operate, maintain, and support the weapon system when fielded. After the list is created, the PM assigns each skill specialty to an ISD analyst.

2.1.2.4 Task Selection and Media Selection Model Selection

The PM selects appropriate Task and Media Selection Models to be used for the ISD analysis. TRANSFORM includes only the 3306th fDES task selection and media selection models.

2.1.2.5 Reports

This area contains the report options available to the PM.

2.1.2.6 Archive

The PM has the option to archive significant portions of an ISD analysis. For example, if detailed ISD analysis has been conducted on a subsystem and that subsystem is later replaced or deleted from the weapon system, the PM may want to save the analysis that has been completed.

2.1.3 ISD Analyst (IA)

Options on the IA's Main Menu are:

- Subsystem Lead Functions
- Task Lead Functions
- ISD Analyst Functions

2.1.3.1 Subsystem Lead Functions

The Subsystem Lead (SL) prepares the list of tasks within assigned subsystems. When LSAR task data change, the SL has the option to incorporate the changes in the subsystem task list. Upon completion of the task list, the SL assigns one ISD Analyst as Task Lead Analyst for each task.

2.1.3.2 Task Lead Functions

The Task Lead (TL) prepares the list of task elements within assigned tasks. If LSAR data are available, the TL is presented with the LSAR Sequential Task Descriptions (STDs), from which the task element list can be created. When LSAR STDs change, the TL has the option to incorporate the changes into the task element list. When the task element list is completed, it becomes available for analysis by any ISD Analyst.

The following paragraphs describe the Task Lead Analyst procedures to determine instructional settings for tasks.

Identify JPA Candidate Tasks/Final JPA Tasks

The analyst is presented with the tasks for which task lead responsibility has been assigned. The TL analyst provides answers to five questions related to factors that influence the desirability and practicality of developing job performance aids (JPAs). The analyst records the approval or disapproval of JPA development and whether or not approved JPAs will completely satisfy task performance requirements.

Determine Instructional Setting

Tasks for which JPAs do not exclusively satisfy performance requirements are presented to the TL. The TL identifies one of four instructional settings for each task: Self-Teaching Exportable Package (STEP), Formal On-the-Job Training (FOJT), Installation Support School (ISS), or Resident School (RS).

2.1.3.3 ISD Analyst Functions

The following paragraphs describe the TRANSFORM ISD Analyst functions.

Create Skill Specialty-Specific Subsystem List

The IA is presented with the weapon system subsystem list previously created by the ISD PM. The IA identifies those subsystems that are specific to the skill specialty assigned to the IA for analysis. One skill specialty-specific subsystem list is created for each skill specialty evaluated in the ISD analysis.

Create Skill Specialty-Specific Task List

The IA is presented with the subsystem task list previously created by the Subsystem Lead Analyst. The IA identifies those subsystem tasks that are specific to the skill specialty assigned to the IA for analysis. One skill specialty-specific task list is created for each skill specialty pertinent to each subsystem.

Create Skill Specialty-Specific Task Element List

The IA is presented with the task element lists previously created by the Task Lead Analyst. The IA identifies those task elements that are specific to the skill specialty assigned to the IA for analysis. One skill specialty-specific task element list is created for each skill specialty pertinent to each task.

Select Task Elements for Training

The IA identifies those task elements that potentially require training. The IA may view available task/task element conditions, cues, and standards (CCCs) and/or LSAR data to assist in determining which task elements need to be trained. TRANSFORM selects task elements for training using 3306th TDES ISD procedures.

Select Skills/Knowledge for Training

The IA identifies those skills/knowledge (S/Ks) that need to be trained. The IA may view available task/task element CCSs and/or LSAR data to assist in determining which S/Ks need to be trained. TRANSFORM selects S/Ks for training using 3306th TDES ISD procedures.

Perform Hardware Evaluation

The IA evaluates all S/Ks requiring training as to whether or not training equipment is the required training media. Task/task element CCSs and/or LSAR data may be presented to support the evaluation. TRANSFORM evaluates hardware training media requirements using 3306th TDES ISD procedures.

Perform Alternate Media Selection

Alternate (non-hardware) media are selected for S/Ks that require training but not on hardware. TRANSFORM selects alternate training media using 3306th TDES ISD procedures. The IA also identifies the training method for each S/K using 3306th TDES ISD logic.

2.1.4 Quality Assurance Reviewer (QAR)

The Quality Assurance Reviewer (QAR) reviews the IA's decision making to ensure that ISD analysis results are well supported and consistent. The QAR is presented with LSAR data, if available, while reviewing the analysts' reasons and rationale for making certain ISD decisions.

2.1.5 Reference File Maintainer (RFM)

The Reference File Maintainer (RFM) is responsible for the development and maintenance of generic duty lists and target population information files for assigned skill specialties. The RFM's procedures requires gathering and reformatting large amounts of non-automated reference information and therefore the RFM's procedures are manual.

2.2 HARDWARE/SOFTWARE

TRANSFORM is comprised of two major subsystems: the VAX LSAR processing subsystem, and the microcomputer ISD analysis subsystem. Figure 2-2 depicts the two subsystems with the major software modules.

2.2.1 VAX Subsystem

The TRANSFORM VAX subsystem extracts and compares LSAR data formatted in accordance with Military Standard (MIL-STD) 1388-2A. The contents of 1388-2A LSA Control Number (LCN) Master Record File and Task Narrative File are read, converted to ASCII format, and downloaded into the VAX. LSAR training-related data elements are extracted, validated, and placed in TRANSFORM LSAR files prepared for downloading to the TRANSFORM microcomputer subsystem. The LSAR-to-ISD data interface is currently automated in one direction only. Feedback to the LSA process is accomplished by having the TRANSFORM produce LSA feedback reports.

At periodic intervals, the TRANSFORM LSAR database is updated by repeating the LSAR data extraction process on updated LCN Master/Task Narrative Files. An LSAR change file is then constructed by comparing certain LSAR data elements in the old and new TRANSFORM LSAR files. For those data elements compared, LSAR changes (LSAR data element additions, deletions, and modifications) are then downloaded to the TRANSFORM microcomputer subsystem. The TRANSFORM LSAR-to-ISD data interface is displayed in Figure 2-3.

Access to a VAX is required to operate the TRANSFORM LSAR data interface. The VAX requires the VMS (Ver 5.5 or greater) operating system. The VAX LSAR data extraction and comparison routines are programmed in Pascal.

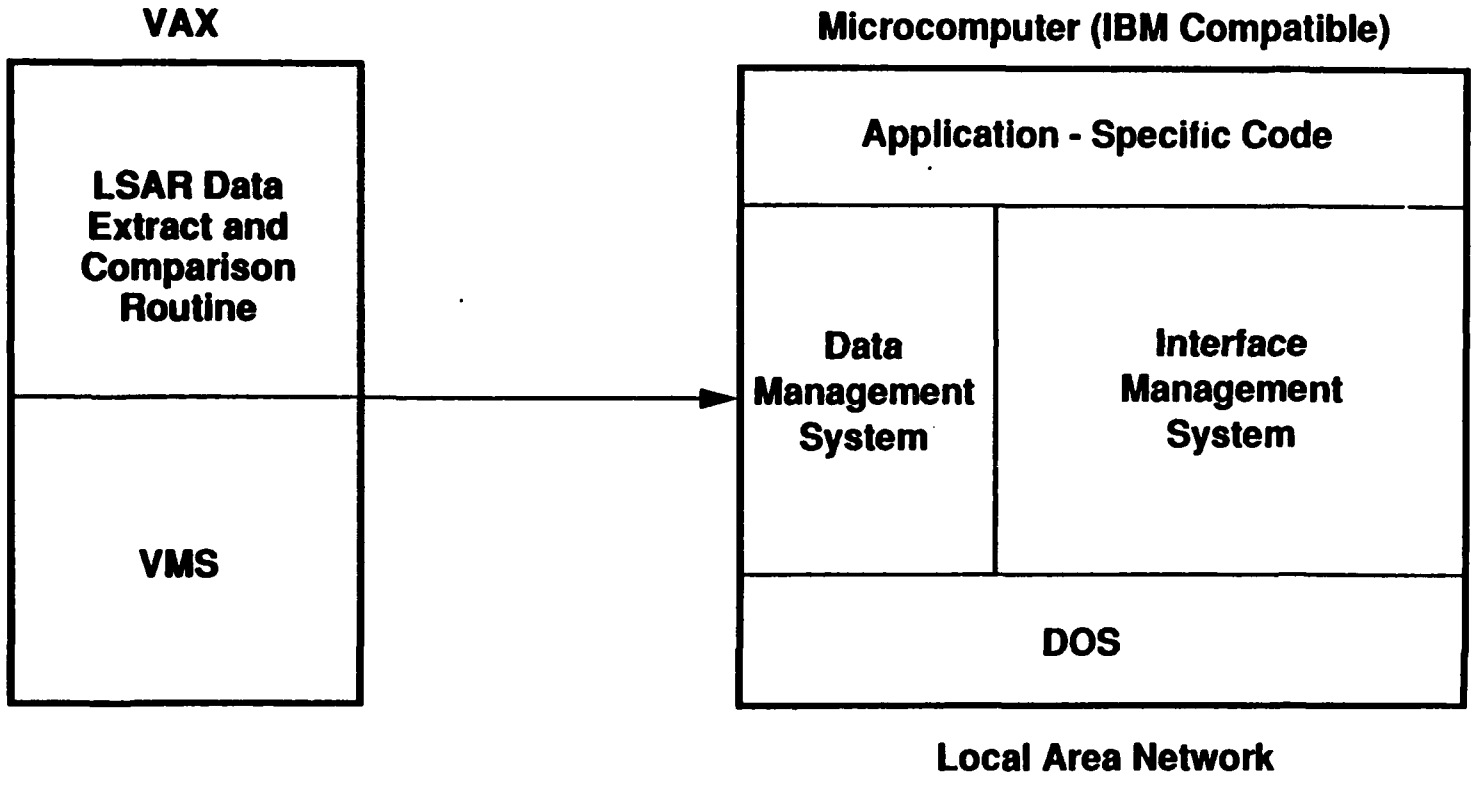

Figure 2-2. The TRANSFORM Hardware/Software Architecture

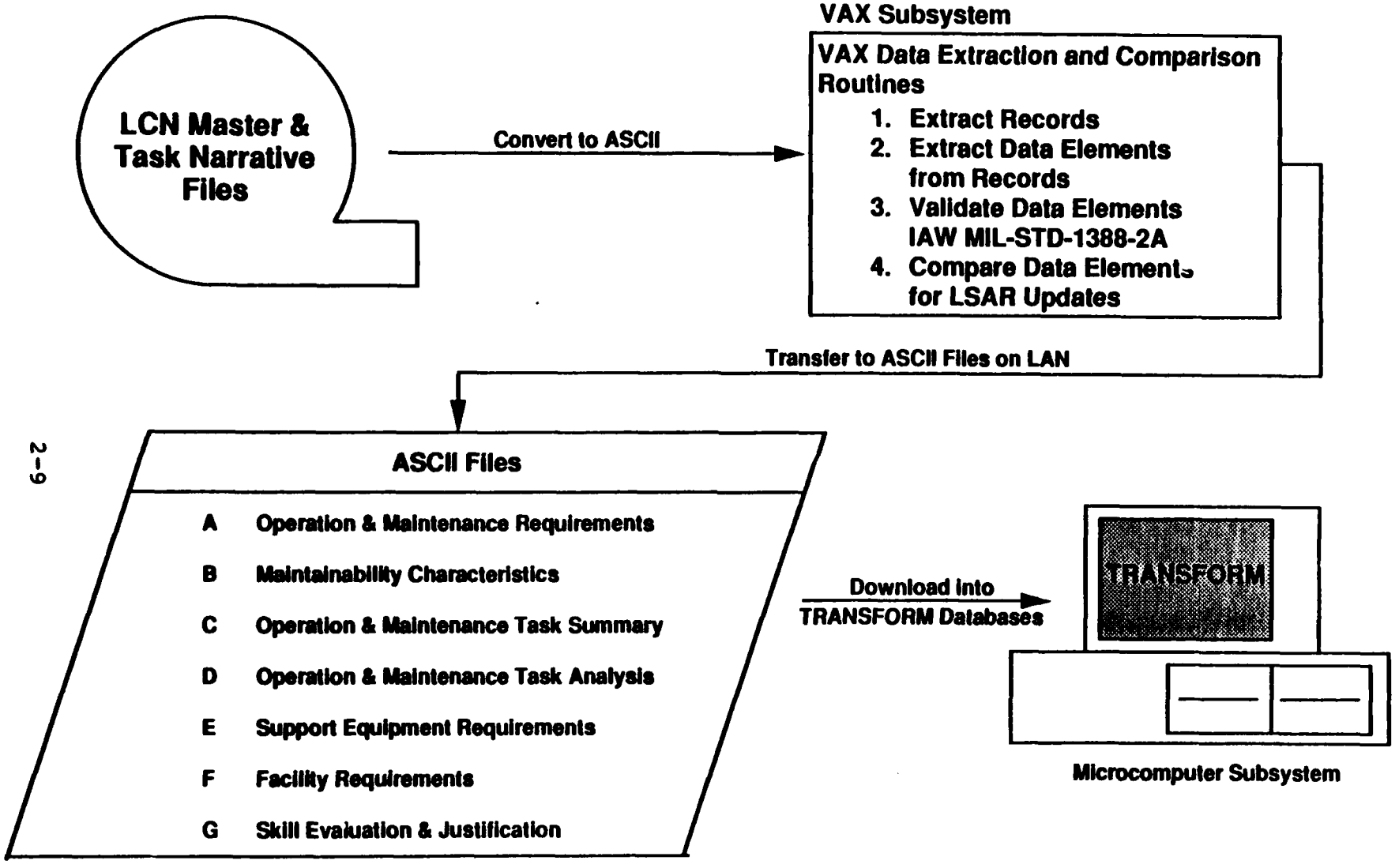

Figure 2-3. TRANSFORM LSAR-to-ISD Interface.

2.2.2 Microcomputer Subsystem

The TRANSFORM microcomputer subsystem is designed as a multi-user ISD analysis system. A Local Area Network (LAN) arrangement of microcomputers is required to conduct an ISD analysis of any magnitude (an ISD analysis requiring a team of analysts). International Business Machine (IBM) compatible personal computers (PCs) are required as the LAN workstations. Each TRANSFORM (Version 2.0) PC requires the following:

- o 8088/80286/80386 microprocessor
- o 640Kb RAM
- o CGA graphics, minimum
- o Monochrome/color monitor
- o MS-DOS 3.0, minimum
- o 40Mb hard disk drive
- o 5-1/4 floppy disk drive

In addition to the DOS operating system, the TRANSFORM microcomputer software consists of the other major software modules shown in Figure 2-2: a data management system, an interface management system, and application-specific code.

The data management system is Microrim's R:Base Program Interface routines. Since TRANSFORM is totally self-contained, there is no requirement to own or have access to the R:Base software.

The interface management system consists of Pascal and Assembler routines previously developed by the Engineering and Management Decision Support (EMDS) section at Dynamics Research Corporation.

The application-specific code is written in Microsoft Pascal.

2.3 TRANSFORM DATA

2.3.1 Database Structure

The TRANSFORM database structure is depicted in Figure 2-4. There are four main databases that contain all system data.

There is one Administrative Database. It contains the following information:

- o Weapon System List and Abbreviations
- o Weapons System Program Managers List
- o System Users and Passwords List
- o Path and File names of ISD and LSAR databases
- o Weapon System LCN Hierarchy

There is one LSAR Database per Weapon System. It contains the following information:

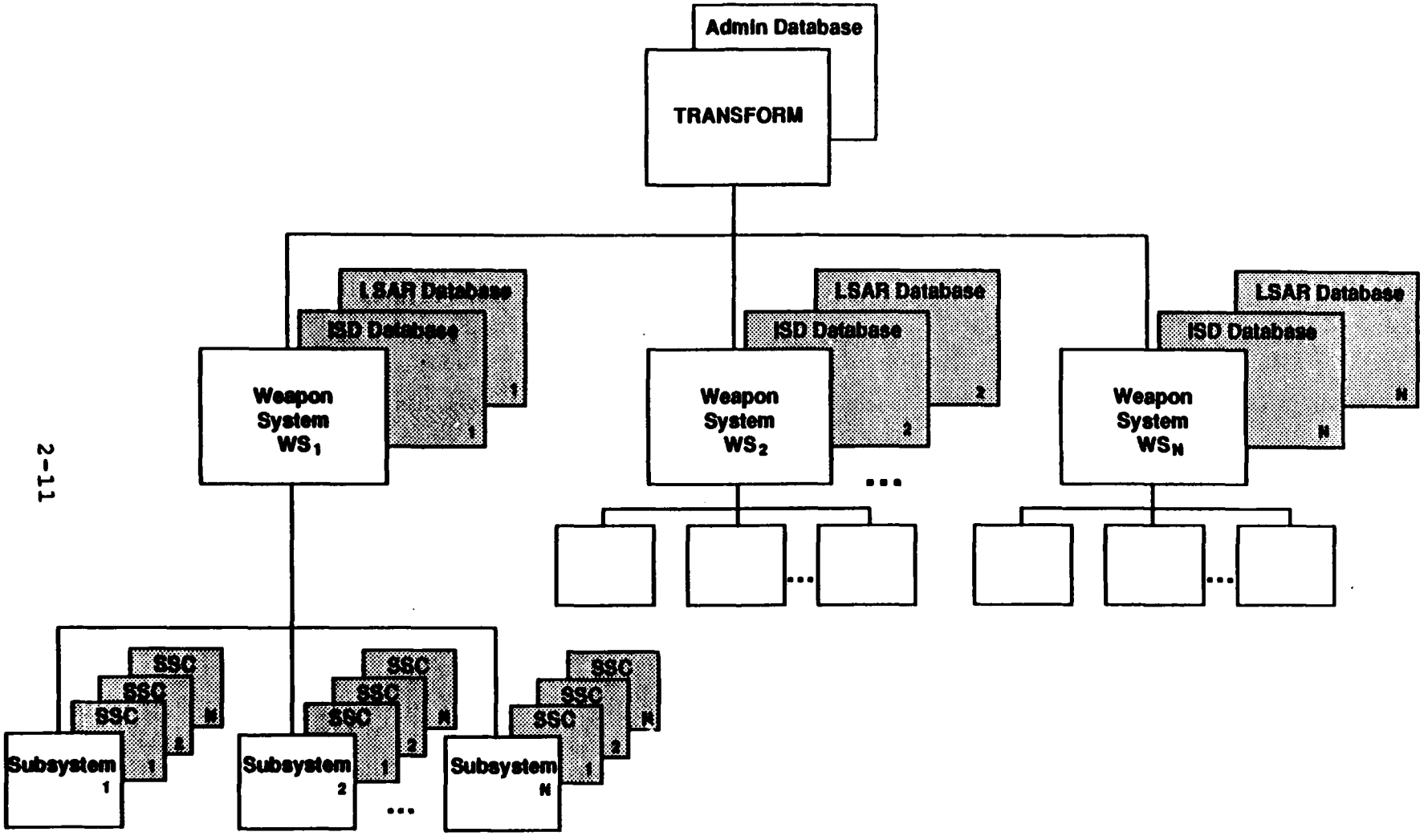

Figure 2-4. TRANSFORM Database Structure.

- All LSAR data
- ISD system-generated LSAR update codes

There is one ISD Database per Weapon System. It contains the following information:

- Subsystem List
- Task List
- Task Element List
- Skill Specialty List
- Subsystem Lead and Task Lead List
- Analyst: SSC Assignments
- SSC-specific Subsystem List
- Path and File names of SSC/Subsystem databases

There is one SSC/Subsystem Database per SSC per Subsystem. It contains the SSC-specific data not found in the other three databases.

2.3.2 Data Elements

A Data Element Dictionary is maintained in accordance with DoD 5000.12-M and MIL-STD-1388-2A. The dictionary provides the following information for each TRANSFORM data element:

- Data Element Name
- Abbreviation
- Definition
- Data Code Structure/Length
- Data Item/Data Code Assigned
- Data Use Identifier
- Reference